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Perinatal care at the limit of viability between 22 and 26 completed weeks of gestation in Switzerland. 2011 revision of the Swiss recommendations

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Abstract: Perinatal care of pregnant women at high risk for preterm delivery and of preterm infants born at the limit of viability (22-26 completed weeks of gestation) requires a multidisciplinary approach by an experienced perinatal team. Limited precision in the determination of both gestational age and foetal weight, as well as biological variability may significantly affect the course of action chosen in individual cases. The decisions that must be taken with the pregnant women and on behalf of the preterm infant in this context are complex and have far-reaching consequences. When counselling pregnant women and their partners, neonatologists and obstetricians should provide them with comprehensive information in a sensitive and supportive way to build a basis of trust. The decisions are developed in a continuing dialogue between all parties involved (physicians, midwives, nursing staff and parents) with the principal aim to find solutions that are in the infant's and pregnant woman's best interest. Knowledge of current gestational age-specific mortality and morbidity rates and how they are modified by prenatally known prognostic factors (estimated foetal weight, sex, exposure or nonexposure to antenatal corticosteroids, single or multiple births) as well as the application of accepted ethical principles form the basis for responsible decision-making. Communication between all parties involved plays a central role. The members of the interdisciplinary working group suggest that the care of preterm infants with a gestational age between 22 0/7 and 23 6/7 weeks should generally be limited to palliative care. Obstetric interventions for foetal indications such as Caesarean section delivery are usually not indicated. In selected cases, for example, after 23 weeks of pregnancy have been completed and several of the above mentioned prenatally known prognostic factors are favourable or well informed parents insist on the initiation of life-sustaining therapies, active obstetric interventions for foetal indications and provisional intensive care of the neonate may be reasonable. In preterm infants with a gestational age between 24 0/7 and 24 6/7 weeks, it can be difficult to determine whether the burden of obstetric interventions and neonatal intensive care is justified given the limited chances of success of such a therapy. In such cases, the individual constellation of prenatally known factors which impact on prognosis can be helpful in the decision making process with the parents. In preterm infants with a gestational age between 25 0/7 and 25 6/7 weeks, foetal surveillance, obstetric interventions for foetal indications and neonatal intensive care measures are generally indicated. However, if several prenatally known prognostic factors are unfavourable and the parents agree, primary non-intervention and neonatal palliative care can be considered. All pregnant women with threatening preterm delivery or premature rupture of membranes at the limit of viability must be transferred to a perinatal centre with a level III neonatal intensive care unit no later than 23 0/7 weeks of gestation, unless emergency delivery is indicated. An experienced neonatology team should be involved in all deliveries that take place after 23 0/7 weeks of gestation to help to decide together with the parents if the initiation of intensive care measures appears to be appropriate or if preference should be given to palliative care (i.e., primary non-intervention). In doubtful situations, it can be reasonable to initiate intensive care and to admit the preterm infant to a neonatal intensive care unit (i.e., provisional intensive care). The infant's clinical evolution and additional discussions with the parents will help to clarify whether the life-sustaining therapies should be continued or withdrawn. Life support is continued as long as there is reasonable hope for survival and the infant's burden of intensive care is acceptable. If, on the other

hand, the health care team and the parents have to recognise that in the light of a very poor prognosis the burden of the currently used therapies has become disproportionate, intensive care measures are no longer justified and other aspects of care (e.g., relief of pain and suffering) are the new priorities (i.e., redirection of care). If a decision is made to withhold or withdraw life-sustaining therapies, the health care team should focus on comfort care for the dying infant and support for the parents.

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Perinatal care at the limit of viability between 22 and 26 completed weeks of gestation in Switzerland

2011 Revision of the Swiss recommendations

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Summary

Perinatal care of pregnant women at high risk for preterm delivery and of preterm infants born at the limit of viability (22–26 completed weeks of gestation) requires a multidisciplinary approach by an experienced perinatal team. Limited precision in the determination of both gestational age and foetal weight, as well as biological variability may significantly affect the course of action chosen in individual cases.

The decisions that must be taken with the pregnant women and on behalf of the preterm infant in this context are complex and have far-reaching consequences. When counselling pregnant women and their partners, neonatologists and obstetricians should provide them with comprehensive information in a sensitive and supportive way to build a basis of trust. The decisions are developed in a continuing dialogue between all parties involved (physicians, midwives, nursing staff and parents) with the principal aim to find solutions that are in the infant's and pregnant woman's best interest.

Knowledge of current gestational age-specific mortality and morbidity rates and how they are modified by prenatally known prognostic factors (estimated foetal weight,

sex, exposure or nonexposure to antenatal corticosteroids, single or multiple births) as well as the application of accepted ethical principles form the basis for responsible decision-making. Communication between all parties involved plays a central role.

The members of the interdisciplinary working group suggest that the care of preterm infants with a gestational age between 22 0/7 and 23 6/7 weeks should generally be limited to palliative care. Obstetric interventions for foetal indications such as Caesarean section delivery are usually not indicated. In selected cases, for example, after 23 weeks of pregnancy have been completed and several of the above mentioned prenatally known prognostic factors are favourable or well informed parents insist on the initiation of life-sustaining therapies, active obstetric interventions for foetal indications and provisional intensive care of the neonate may be reasonable.

In preterm infants with a gestational age between 24 0/7 and 24 6/7 weeks, it can be difficult to determine whether the burden of obstetric interventions and neonatal intensive care is justified given the limited chances of success of such a therapy. In such cases, the individual constellation

of prenatally known factors which impact on prognosis can be helpful in the decision making process with the parents. In preterm infants with a gestational age between 25 0/7 and 25 6/7 weeks, foetal surveillance, obstetric interventions for foetal indications and neonatal intensive care measures are generally indicated. However, if several prenatally known prognostic factors are unfavourable and the parents agree, primary non-intervention and neonatal palliative care can be considered.

All pregnant women with threatening preterm delivery or premature rupture of membranes at the limit of viability must be transferred to a perinatal centre with a level III neonatal intensive care unit no later than 23 0/7 weeks of gestation, unless emergency delivery is indicated. An experienced neonatology team should be involved in all deliveries that take place after 23 0/7 weeks of gestation to help to decide together with the parents if the initiation of intensive care measures appears to be appropriate or if preference should be given to palliative care (i.e., primary non-intervention). In doubtful situations, it can be reasonable to initiate intensive care and to admit the preterm infant to a neonatal intensive care unit (i.e., provisional intensive care). The infant's clinical evolution and additional discussions with the parents will help to clarify whether the life-sustaining therapies should be continued or withdrawn.

Life support is continued as long as there is reasonable hope for survival and the infant's burden of intensive care is acceptable. If, on the other hand, the health care team and the parents have to recognise that in the light of a very poor prognosis the burden of the currently used therapies has become disproportionate, intensive care measures are no longer justified and other aspects of care (e.g., relief of pain and suffering) are the new priorities (i.e., redirection of care). If a decision is made to withhold or withdraw life-sustaining therapies, the health care team should focus on comfort care for the dying infant and support for the parents.

Key words: *limit of viability; ethical decision-making; provisional intensive care; redirection of care*

Introduction

These recommendations refer to the perinatal care of women at high risk of preterm delivery and preterm infants at the limit of viability (gestational age between 22 and 26 completed weeks). They have been written for physicians, midwives, nurses and other professionals who are involved in the care of this high risk population.

The first recommendations for the care of infants born at the limit of viability were published in Switzerland in 2002 [1]. At the time, recommendations of European [2, 3] and Canadian [4] societies were reviewed, and together with the relevant ethical guidelines of the Swiss Academy of Medical Sciences [5, 6] served as the basis for these recommendations. The fact that revised recommendations from North America and Europe [7–11] as well as new recommendations from additional countries [12–17] have since been published and new mortality and morbidity data [18–22], including results from Switzerland [23, 24], have become available, has prompted the Swiss Society of

Neonatology to recommend the revision of the Swiss recommendations.

National recommendations are necessary because ethical decision making is not only based on widely accepted ethical principles but also strongly influenced by social, economic and legal considerations. High quality outcome research is important and results from such studies vary considerably between different countries [18–24]. Therefore, adoption of similar guidelines from other countries would be unlikely to gain wide acceptance in Switzerland. Such acceptance, however, is important to minimize potentially problematic centre-to-centre variability in the care of women at high risk of preterm delivery and their infants.

The new recommendations were elaborated by a group of experienced specialists. The current literature was reviewed and representatives of each specialty contributed to the respective chapters of the new recommendations. The changes were discussed in detail during five meetings in 2009 and 2010. The final version of the new recommendations was approved by all members of the working group as well as the Swiss Society of Gynaecology and Obstetrics, the Swiss Academy of Fetomaternal Medicine, the Swiss Association of Midwives, the Swiss Society of Paediatrics, the Swiss Society of Neonatology and the Swiss Society of Developmental Paediatrics. As in 2002, the Central Ethical Committee of the Swiss Academy of Medical Sciences supports the new recommendations.

Compared with the 2002 version, the new recommendations include specific information on obstetrical interventions, in particular on foetal lung maturation and the role of Caesarean section delivery. Up-to-date information on current mortality and morbidity rates is provided. In the previous version of the recommendations, gestational age was the main determinant for the suggested management algorithm. The new recommendations highlight the fact that apart from stratification by gestational age, factors significantly affecting prognosis must be taken into account. The grey zone is more narrowly defined but its borders are not absolute allowing for an individualised approach in the perinatal care at the limit of viability. The importance of communication skills is again emphasised and the role of the parents in the decision making process is explained in more detail.

Background

Calculation of gestational age and birth weight and biological variability

The *International Classification of Disease (10th revision)* defines the gestational age as the postmenstrual age in weeks and days. The time period between 25 weeks and 0 days (25 0/7 weeks) and 25 weeks and 6 days (25 6/7 weeks), for example, corresponds to 175–181 days and is termed 25 completed weeks of gestation; the foetus is in the 26th week of gestation.

The calculation of the gestational age is generally based on ultrasound measurements of the crown-rump length in early pregnancy (10 0/7 to 13 6/7 weeks of gestation) and/or the history of the first day of the last menstrual period. It is important to realise that the precision of gestation-

al age determination by early ultrasound is ± 4 days [25, 26], whereas a much wider range of -6 to $+14$ days must be accepted when the history of the last menstrual period is used. When there is no early ultrasound estimate of the gestational age, clinical assessment after delivery may lead to a revision of the estimated gestational age. Similarly, ultrasonographic estimations of foetal weight can vary from the actual weight by $\pm 15\%$ and thus significantly affect prognosis. The parents need to be informed about possible inaccuracies of these measurements to avoid unnecessary confusion in such a situation.

Because there can be variability in maturity at any given gestational age, preterm infants of identical gestational age may exhibit significantly different biological maturity which in turn may influence their therapeutic requirements and even affect individual mortality and morbidity risks. It has been shown by different researchers that some factors that can be determined prenatally have an impact on prognosis [20, 27].

Current mortality and morbidity rates

Knowledge of reliable mortality and morbidity rates is of utmost importance for sound perinatal decision making. Gestational age is the most important prognostic factor. However, sex, estimated foetal weight, single or multiple birth and exposure or non-exposure to antenatal corticosteroids are additional relevant factors that affect mortality and morbidity risks of preterm infants with a gestational age <26 completed weeks (table 1). Apart from published national and international statistics, local outcome data of preterm infants at the limit of viability are essential.

Mortality

With the continuing progress of neonatal intensive care, the limit of viability has continued to shift towards younger gestational ages. For example, survival after only 22 completed weeks of gestation has been described [3, 28]. A comparison between published international figures [18–22] and results of the Swiss Minimal Neonatal Data Set (MNDS) [23, 24] shows that there are considerable differences in mortality rates between different countries.

In Switzerland, mortality rates of preterm infants born at the limit of viability vary significantly between different centres that care for such patients [23]. At the same time, mortality rates continue to decrease internationally and have reached 33–49% for preterm infants with a gestational age between 24 0/7 and 24 6/7 weeks [18–22]. On the other hand, mortality rates for infants born in the 24th week of gestation (i.e., with a gestational age between 23 0/7 and 23 6/7 weeks) remain above 60% at most centres [18, 20–22] (table 2).

Morbidity

The selection of suitable follow-up studies to determine the prevalence of neurosensory deficits in surviving extremely preterm infants is hampered by study design heterogeneity, inadequate size of study populations and variability in age at follow-up. Therefore, only the four largest multicentre studies that were published in the last five years which described the outcome of large cohorts were analysed [20, 21, 29, 30]. In addition, only rates of severe impairment (PDI and/or MDI <70 , moderate or severe cerebral palsy, blindness, deafness) and profound impairment (PDI and/or MDI <50 or IQ <55 , adult assistance is required to move, blindness, deafness) were evaluated since only these are potentially relevant in ethical life and death decision making.

Among surviving preterm infants with a gestational age ≥ 25 0/7 weeks, rates of severe and/or profound impairment are generally less than 50%. At lower gestational ages, however, these rates increase markedly but vary significantly between different studies for infants of the same gestational age (table 3).

Ethical considerations

High mortality and morbidity rates of extremely preterm infants as a group (tables 2 and 3), on the one hand, and prognostic uncertainty in individual cases, on the other hand, render ethical decision making difficult. The limit beyond which health care professionals feel that intensive care measures are no longer justified is influenced by their cultural and personal background. There is, however, general consensus regarding the importance of the relevant

Table 1: Prognostic impact of prenatally known factors (sex, estimated foetal weight, single or multiple birth and exposure or non-exposure to antenatal corticosteroids) on gestational age-specific outcomes [20].

Gestational age (weeks)	Sex	Birth weight	Singleton	ANC ¹	Survival rate ²	Survival without profound impairment ^{2,3}	Survival without severe impairment ^{2,4}
24 0/7 – 24 6/7	m	600 g	no	no	27%	15%	7%
24 0/7 – 24 6/7	f	600 g	no	no	36%	24%	14%
24 0/7 – 24 6/7	f	800 g	no	no	63%	48%	34%
24 0/7 – 24 6/7	f	800 g	yes	no	67%	53%	39%
24 0/7 – 24 6/7	f	800 g	yes	yes	82%	71%	57%

¹ antenatal corticosteroids to accelerate foetal lung maturation

² as percentage of all live born infants (n = 4446)

³ profound impairment Bayley score <50 (untestable)

• level 5 for gross motor function (adult assistance required to move)

⁴ severe impairment at the age of 18–22 months:

• PDI and/or MDI ≤ 70

• moderate or severe CP

• bilateral blindness

• bilateral hearing loss requiring amplification

These estimates are based on standardised assessments of outcomes at 18 to 22 months of infants born at Neonatal Research Network (NRN) centers between 1998 and 2003; infants were 22 to 25 weeks, between 401 and 1,000 grams at birth. Infants not born at a Network center and Infants with a major congenital anomaly were excluded.

ethical principles proposed by Beauchamp and Childress [31]. It is widely accepted that beneficence, non-maleficence, autonomy and justice must be considered, but several conflicts arise when these principles are applied to the situation of preterm infants at the limit of viability [32].

Physician's duty to preserve life

A first conflict arises from the question of how the physician's duty to preserve life could be modified by thoughts about the achievable quality of life. If it is not permissible to take the quality of life into account and human life must be supported with all available means, there is a risk of excessive therapy. On the other hand, to only accept life-prolonging therapies if a certain quality of life can be guaranteed to the preterm infant must be regarded as discrimination toward the disabled. A possible compromise between these two extreme positions might be to always ask the question if the suffering imposed on the patient by the various interventions can be ethically justified when confronted with a very unfavourable prognosis.

The decision to withhold or withdraw life-sustaining therapies is motivated by the desire to protect the preterm infant from undue suffering and not by the wish to prevent survival with handicaps.

Decision making when there is prognostic uncertainty

Mortality and morbidity rates of preterm infants show a strong correlation with gestational age leading to world-

wide agreement that there is a limit below which life-sustaining therapies will not be successful and, therefore, should not be used. Similarly, it is also generally accepted that there is a gestational age limit above which non-initiation of life-sustaining intensive care measures could not be ethically justified. Since improvement of prognosis is not sudden but gradual, there is a grey zone between those two limits which is characterised by uncertainty. Consequently, there is no consensus if the burden of life-sustaining therapies in these borderline viable infants is acceptable or not.

Within this grey zone, an additional line can be drawn indicating the limit where the judgement of the reasonableness of the burden of intensive care changes from negative to positive. With this concept in mind, four zones that require different courses of action can be differentiated (table 4).

The precise designation of the borders of these zones will be influenced by the best available mortality and morbidity data observed among patients of a particular gestational age, both nationally and locally, but will also be affected by individual values. How can the chance of survival with a good quality of life be balanced against the risk of dying or surviving with a severely restricted quality of life after having experienced the full burden of intensive care? A national consensus regarding the designation of these borders

Table 2: Comparison of mortality rates reported from Switzerland, the United States, Sweden and Australia.

Gestational age (weeks)	Mortality rates ¹						
	Switzerland (2000–2004) ² [23] n = 516	Switzerland (2005–2009) ² [unpublished] n = 562	USA – NICHD (1998–2003) [20] n = 4446	USA – NICHD (2003–2007) [22] n = 4160	USA – VON (1998–2003) [21] n = 4477	Sweden (2004–2007) [19] n = 707	Australia (2005) [18] n = 157
22 0/7 – 22 6/7	100% (NA)	100% (NA)	95%	94%	96%	90%	95%
23 0/7 – 23 6/7	89% (80–100)	96% (73–100)	74%	74%	62%	48%	78%
24 0/7 – 24 6/7	70% (47–100)	69% (27–100)	44%	45%	37%	33%	49%
25 0/7 – 25 6/7	49% (26–62)	39% (11–62)	25%	28%	24%	19%	33%

¹ as percentage of all live born infants

² figures in parenthesis indicate ranges between the centres

Table 3: Mortality rates and rates of permanent neurosensory impairment among extremely preterm infants.

Gestational age (weeks)	Mortality rates ¹	Survival with profound impairment ^{2,3}	Survival with severe impairment ^{2,4}	Survival without severe or profound impairment ²⁻⁴
22 0/7 – 22 6/7	94–95% [20, 21]	60% [20]	73–80% [20, 21]	20–27% [20, 21]
23 0/7 – 23 6/7	62–74% [20, 21]	20–38% [20, 28, 29]	27–52% [20, 21, 28]	10–53% [20, 21, 28]
24 0/7 – 24 6/7	37–44% [20, 21]	23–40% [20, 28, 29]	22–44% [20, 21, 28]	16–55% [20, 21, 28]
25 0/7 – 25 6/7	24–25% [20, 21]	17–25% [20, 28, 29]	22–27% [20, 21, 28]	48–61% [20, 21, 28]

¹ as percentage of all live born infants

² as percentage of survivors

³ profound impairment Bayley score <50 (untestable)

• level 5 for gross motor function (adult assistance required to move)

⁴ severe impairment at the age of 18–22 months:

- PDI and/or MDI ≤70
- moderate or severe CP
- bilateral blindness
- bilateral hearing loss requiring amplification

is important to guarantee a just distribution of health care resources and to avoid a problematic medical tourism.

These gestational age limits cannot be used schematically for decision making in individual patients. Factors that can be determined prenatally and are known to impact on prognosis must be adequately considered since they can shift the patient's individual prognosis from one zone to another (table 1). Finally, individual values of the members of the health care team and particularly of the parents will also play a role.

Decision maker

Since the preterm infant whose life is directly affected by the treatment decisions cannot communicate his/her preferences, decisions must be made by proxy. Basically, this surrogate role could potentially be played by the health care team, the parents of the infant or by a societal body, such as an ethics committee or a court of law.

Ideally, such decisions should not be made by a single party at a particular point in time but should rather be developed in an ongoing dialogue between all parties involved (physicians, nursing staff, parents) (i.e., shared decision making). In a first step, the health care team must determine which therapeutic recommendations will result, based on the above defined criteria. If these fall within the grey zone, discussions with the parents will help to define which decisions correspond best with the values of the parents.

Parental preferences are particularly important when the health care team is confronted with considerable ethical dilemmas (table 4). In general, parental authority should be respected when an intervention has to be classified as not (zone B) or conditionally (zone C) recommended. However, parental authority is not unlimited: they cannot insist on an unreasonable intervention (zone A), neither can they reject a therapy that their infant very likely would benefit from (zone D). It is important to realise that depending on their cultural background, parental wishes and abilities to participate in the decision making process can differ considerably.

Since there is no possibility to prove the moral correctness of decisions taken when faced with an ethical dilemma, successful decision making will be defined by how the parties involved (parents, health care team) judge the process and how they cope with the consequences of the decision in the long run. Experience has shown that the following aspects characterise decision making that will least likely result in persistent accusations and feelings of guilt: open and careful information of the parents adapted to their needs, sound and credible justification of the decision as

well as honest and empathic communication and support [33].

Health care resources

The question could be raised whether a considerable proportion of available health care resources should be allocated to the treatment of barely viable preterm infants with a very unfavourable prognosis, if at the same time resources are lacking in other areas of the health care system.

If rationing of potentially helpful therapies is unavoidable, it should be done by rejecting therapies with marginal effectiveness, limited usefulness or a very poor cost-benefit ratio for all patients rather than by excluding certain categories of patients (e.g., preterm infants at the limit of viability) from a particular therapy. Such decisions must always be made on a societal level; economic considerations should not interfere with ethical decision making in an individual case.

Communication

Prenatal ethical decision making regarding maternal and foetal interventions at the limit of viability is rationally and emotionally challenging both for parents and physicians. To communicate complex issues in an appropriate way and adapted to the parent's level of understanding requires competence and experience. Therefore, these discussions must be led by experienced and appropriately trained obstetricians and neonatologists. The goal of these conversations is to establish a trusting relationship between the parents and the health care team. The parents should be provided with adequate information so that they can actively participate in the decision making regarding pre- and postnatal maternal and infant care.

Communication among members of the perinatal team

The perinatal care of a foetus or a preterm infant at the limit of viability must follow a multidisciplinary approach and requires close cooperation among obstetricians, neonatologists, midwives, nurses and other involved parties. Frequently, decisions have to be made within a short period of time. It is therefore necessary that the members of the perinatal team have previously discussed and agreed upon a standard approach in such situations.

Communication with the parents

Obstetricians and neonatologists should inform both parents about the situation of the unborn child and his/her likely short- and long-term prognosis. This information should be precise, comprehensive and unbiased and should be presented using appropriate expressions and understandable language. It has been shown that the way messages

Table 4: Stratification of decision making at the limit of viability: zones B and C designate the grey zone.

Zone	Intensive care	Burden	Comment
A	not indicated	not acceptable	parents cannot insist on an unreasonable intervention
B	not recommended, but acceptable in individual cases	likely not to be acceptable	parental authority should be respected
C	conditionally recommended, but non-initiation acceptable in individual cases	likely to be acceptable	parental authority should be respected
D	recommended	acceptable	parents cannot reject interventions that is in the infant's best interest

are relayed significantly influences the parent's perception of their child's condition and their treatment decisions [34]. Therefore, information should not only focus on mortality and handicap rates but also mention chances for intact survival to avoid inappropriately influencing the decision making. Great care must be taken that the parent's cultural background and their ability to understand complex issues are adequately taken into account. In doubtful situations, the services of professional translators or cultural mediators should be used liberally. Parental expectations and hopes should be carefully explored and compared to the published prognostic data. Frequently, parents have unrealistic expectations not only of what is medically feasible but also of the prognosis of their child, independent of which therapeutic options are recommended. It is important to realise that outcome data describe probabilities of a cohort that can easily be misinterpreted by the parents. Therefore, it is crucial that parents understand that there is always some degree of uncertainty regarding the prognosis of an individual child.

Following detailed information, most parents are grateful when physicians suggest a treatment plan. Physicians are obliged to support parents in their role as their child's proxy. Parents should be given sufficient time to ask questions, to address unclear issues of the conversation or to weigh risks and benefits of the proposed therapeutic strategies. Further conversations among family members or support by members of the hospital clergy can be helpful. Parents should also be informed that because of the imprecision of prenatal estimates of gestational age and foetal weight it may occasionally be necessary to revise prenatal agreements immediately after birth.

Occasionally, there is a need for several conversations, particularly when pregnancy continues and the infant's prognosis changes. Because continuity and emotional relations are important to parents, additional discussions should be lead by the same physicians. Written documentation of the contents of all conversations and agreements made regarding the care of the mother and her infant should readily be available to all involved teams.

Parents should be informed that even if no resuscitative efforts will be made, the infant will likely be born alive and possibly live for several hours. If necessary, the infant will receive analgesics to relieve any suffering (palliative care) and will remain with the parents who will be supported by the health care team. This will also apply if resuscitative efforts are not successful.

Perinatal care at the limit of viability between 22 and 26 completed weeks of gestation

Prior to delivery

When foetal or maternal risk factors that may lead to the delivery of an infant at the limit of viability are recognised, obstetricians and neonatologists should discuss with the parents the possibilities and limitations of the care of extremely preterm infants. Pregnant women at risk of preterm delivery should be informed about the advantages of early intrauterine transfer to a perinatal centre.

In utero transfer

Criteria for timely transfer of mothers experiencing threatened preterm delivery must be defined clearly and should be evaluated on a regular basis. Transfer of mothers at risk to a perinatal centre should occur no later than at 23 0/7 weeks and possibly earlier if additional complications are present (e.g., premature rupture of membranes). Although no intensive care measures would be initiated at this age should delivery occur, transfer of the pregnant women allows for detailed counselling and preparation of the parents. Parents should be informed about the referral in such a way that their expectations are appropriate and remain realistic regarding their individual situation. In particular, parents must be told that the prognosis regarding mortality and morbidity of infants born at the limit of viability

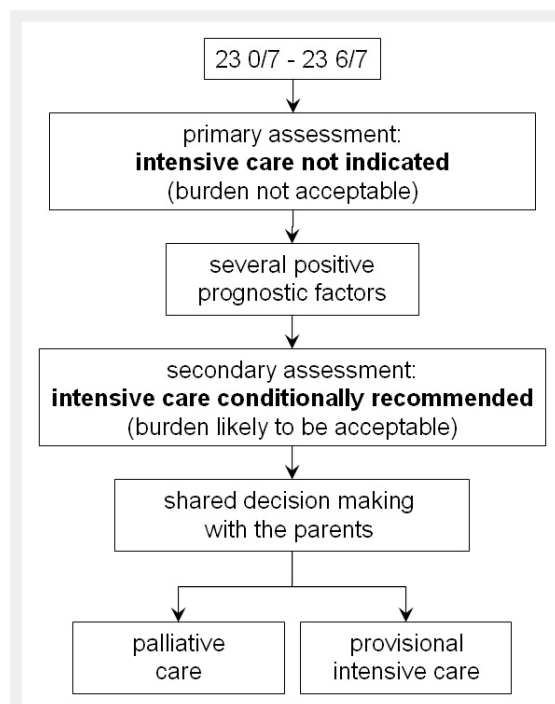


Figure 1

Impact of positive risk factors on shared decision making with the parents in preterm infants with a gestational age between 23 0/7 and 23 6/7 weeks.

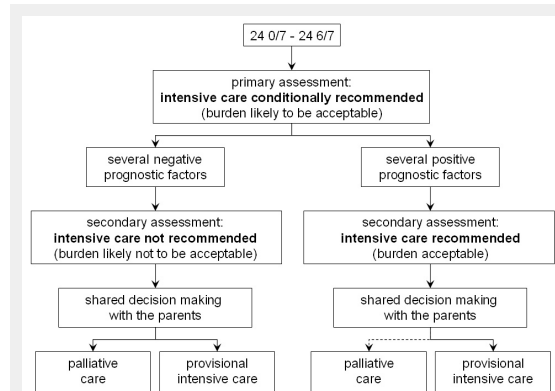


Figure 2

Impact of positive or negative risk factors on shared decision making with the parents in preterm infants with a gestational age between 24 0/7 and 24 6/7 SSW.

is better when the transfer to a level III perinatal centre occurs prior to delivery.

Obstetrical interventions (table 5)

Antenatal corticosteroids to accelerate foetal lung maturation

In the presence of threatened preterm delivery, foetal lung maturation should be accelerated as early as 24 0/7 weeks of gestation with a single course of 2 doses of betamethasone 12 mg i.m. 24 hours apart [33–38]. In certain situations, acceleration of foetal lung maturation can be started a few days earlier, but not before 23 0/7 weeks [39]. As an exception, a second course can be administered if the first two doses of betamethasone have been given very early and the risk of preterm delivery has again increased [40].

Delivery, delivery mode and placental period

After 24 0/7 weeks of gestation, active interventions for foetal indications should be considered after completion of the acceleration of foetal lung maturation; in special situations, particularly at the explicit wish of the fully informed parents, it may also be considered prior to 24 0/7 weeks of gestation, but not before 23 0/7 weeks of gestation. Guidance regarding the impact of the mode of delivery, particularly Caesarean section, on the prognosis of preterm infants at the limit of viability can only be obtained from retrospective studies and international recommendations from experts [41–44]. In general, a Caesarean section should not be performed routinely because of the gestational age alone, since rates of neurosensory impairment have not decreased despite increasing rates of Caesarean sections [45]. If the infant is in cephalic position, intra-

partum surveillance is possible and there are no maternal and/or foetal risk factors, a Caesarean section does not offer any benefit [46]. Caesarean section may reduce perinatal mortality of preterm infants with a gestational age <25 0/7 weeks, in multiples, in infants in breech presentation and in growth restricted preterm infants with a gestational age between 26 and 30 weeks [47–49]. The foetus should be monitored with intrapartum cardiotocography (adapted to the gestational age) in order to be able to intervene when foetal well-being is threatened.

Different surgical techniques (classical vertical uterotomy versus transverse uterotomy) have a significant influence on postpartal morbidity, the risk of preterm delivery and uterine rupture in subsequent pregnancies [50].

The delivery of a preterm infant at the limit of viability should be optimised by additional obstetrical interventions. It has been shown that delayed cord clamping and cord milking is associated with improved haemodynamic stability, a decreased blood transfusion requirement and a lower incidence of intraventricular haemorrhages in preterm infants with a gestational age of less than 34 0/7 weeks [51].

After delivery

Initial resuscitation in the delivery room (table 6)

Since the decisions whether intensive care measures should be initiated in the delivery room are very complex and difficult with far reaching consequences, the birth of a preterm infant at the limit of viability should be regarded as an emergency that requires the presence of experienced obstetricians and neonatologists.

The individual interventions will be influenced by prenatally known and prognostically relevant factors (gestational age, estimated foetal weight, sex, exposure or non-exposure to antenatal corticosteroids, single or multiple birth) (table 1), and – particularly in the grey zone – by parental preferences. It has been demonstrated that the clinical condition of the infant after birth and the response to resuscitative measures are not reliable prognostic factors [52]. Nevertheless, these factors influence the way the parents and the health care team members experience individual situations and cannot be completely ignored.

Resuscitation when gestational age is uncertain

An experienced neonatology team should attend all deliveries that occur at an estimated gestational age ≥ 23 completed weeks in order to decide whether the initiation of intensive care measures appears to be justified or preference should be given to palliative care measures (i.e., primary non-intervention).

In doubtful cases, it is appropriate to initiate intensive care measures and to admit the preterm infant to the neonatal intensive care unit (i.e., to provide provisional intensive care) until the clinical course and further discussions with the parents help clarify whether the treatment should be continued or redirected.

Resuscitation when gestational age is certain

Based on the prenatal discussions with the parents, an experienced neonatology team must decide whether it is reasonable to initiate intensive care measures. Provisional intensive care often enables the health care team to more

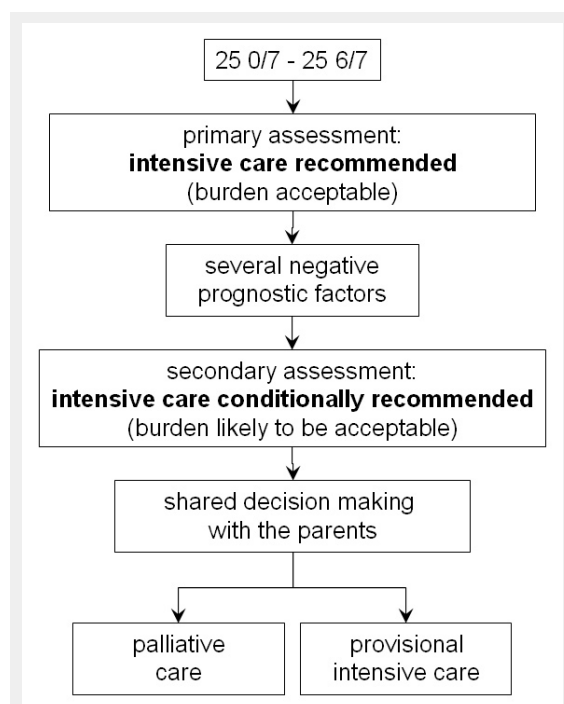


Figure 3

Impact of negative risk factors on shared decision making with the parents in preterm infants with a gestational age between 25 0/7 and 25 6/7 SSW.

fully evaluate the infant's condition at a later time point; this possibly provides better arguments for continuation or withdrawal of intensive care measures.

The care of preterm infants with a gestational age <24 0/7 weeks should generally be limited to palliative measures. If a preterm infant appears significantly more mature after delivery or if previously well-informed parents insist, provisional intensive care can be started until the clinical course helps to decide if intensive care measures should be continued. Provisional intensive care can also be reasonable in selected cases when several of the above mentioned prenatally known factors positively influence the prognosis (fig. 1).

In preterm infants with a gestational age between 24 0/7 – 24 6/7 weeks, it can be difficult to determine whether the burden of intensive care is justified given the limited chances of success of such a therapy. In such cases, the individual constellation of additional prenatally known prognostic factors can be helpful in the decision making process with the parents (fig. 2).

In preterm infants with a gestational age ≥25 0/7 weeks, intensive care measures are generally indicated. However, if several prenatally known factors are unfavourable and the parents agree, primary non-intervention and palliative care can be considered (fig. 3).

Decision making in the neonatal intensive care unit

Provisional intensive care

Intensive care interventions that are initiated in the delivery room and continued in the neonatal intensive care unit are based on the therapeutic goal. The primary aim is to help the infant survive and to minimise potential permanent impairments.

If a decision is made to provide provisional intensive care to a preterm infant at the limit of viability, the treatment should be optimised to avoid secondary injuries at all cost.

To refrain from applying intensive care interventions that are used in more mature preterm infants is not justified.

As long as there is reasonable hope that the primary goal can be reached and the burden of the interventions used appears justified, the necessary therapies are continued. The parents should be informed regularly about the infant's clinical course.

Redirection of care

If the health care team and the parents have to recognise that the primary goal can no longer be reached, intensive care measures are no longer justified and other aspects of care (e.g., the use of opioids to diminish pain and suffering) become the new priorities (i.e., redirection of care to comfort measures). Decisions regarding withdrawal of intensive care measures should be carefully documented in the patient record. These notes should include a detailed description of the considerations and reasons that have led to a particular decision.

Palliative care

Whenever life sustaining therapies are withheld (either primarily or secondarily), everything should be done to allow the infant to die peacefully and with dignity (i.e., comfort care). At the same time, the parents should be given the opportunity of close contact with their dying child to bid farewell. If necessary for adequate pain control, opiates can be used at doses that might have a life-shortening effect [5]. In contrast, the use of drugs with the primary intention to end a preterm infant's life is against the law and not consistent with the ethical position described above.

Recommendations for quality assessment and improvement

Quality assessment and improvement plays an important role in the care of preterm infants born at the limit of viability.

Table 5: Algorithm and classification of obstetrical interventions.

Gestational age (weeks)	In utero transfer to a perinatal centre	Antenatal corticosteroids	Caesarean section
<22 0/7	not indicated	not indicated	only for maternal indications
22 0/7 – 22 6/7	possibly indicated	not indicated	only for maternal indications
23 0/7 – 23 6/7	indicated	possibly indicated	rarely for foetal indications
24 0/7 – 24 6/7	indicated	indicated	to be considered for foetal indications
25 0/7 – 25 6/7	indicated	indicated	to be considered for foetal indications

Note: gestational age stratification of obstetrical and neonatal interventions is only a first step in the decision making process. Prenatally known prognostic factors (sex, estimated foetal weight, single or multiple birth and exposure or non-exposure to antenatal corticosteroids) can have a significant impact on mortality and morbidity rates (see table 1). *Inborns* have a better prognosis than *outborns*. The clinical condition of the infant immediately after birth and the response to resuscitative measures are not reliable prognostic factors.

Table 6: Algorithm and classification of neonatal interventions.

Gestational age (weeks)	Neonatal care	Classification of intensive care measures
<22 0/7	comfort care	not indicated (burden not acceptable)
22 0/7 – 22 6/7	comfort care	not indicated (burden not acceptable)
23 0/7 – 23 6/7	generally comfort care	not recommended, but acceptable in individual cases (burden likely not to be acceptable)
24 0/7 – 24 6/7	generally provisional intensive care	conditionally recommended, but non-institution acceptable in individual cases (burden likely to be acceptable)
25 0/7 – 25 6/7	provisional intensive care	recommended (burden acceptable)

Note: gestational age stratification of obstetrical and neonatal interventions is only a first step in the decision making process. Prenatally known prognostic factors (sex, estimated foetal weight, single or multiple birth and exposure or non-exposure to antenatal corticosteroids) can have a significant impact on mortality and morbidity rates (see table 1). *Inborns* have a better prognosis than *outborns*. The clinical condition of the infant immediately after birth and the response to resuscitative measures are not reliable prognostic factors.

ity. It is indispensable to prospectively collect data on mortality and morbidity that are periodically reviewed both nationally and locally. In addition, information on motor and cognitive development of these children should be collected up to school age. It is imperative that the necessary resources are made available. To be able to guarantee a high quality of perinatal care and follow-up, these infants must be treated and followed by adequately trained and qualified professionals in specialised level III centres.

Available studies from Switzerland document that most deaths in neonatal intensive care units are preceded by redirection of care decisions [53–55]. In the future, decisions that lead to withholding or withdrawing of life-sustaining therapies either in the setting of primary non-intervention or following redirection of care should be prospectively collected and analysed.

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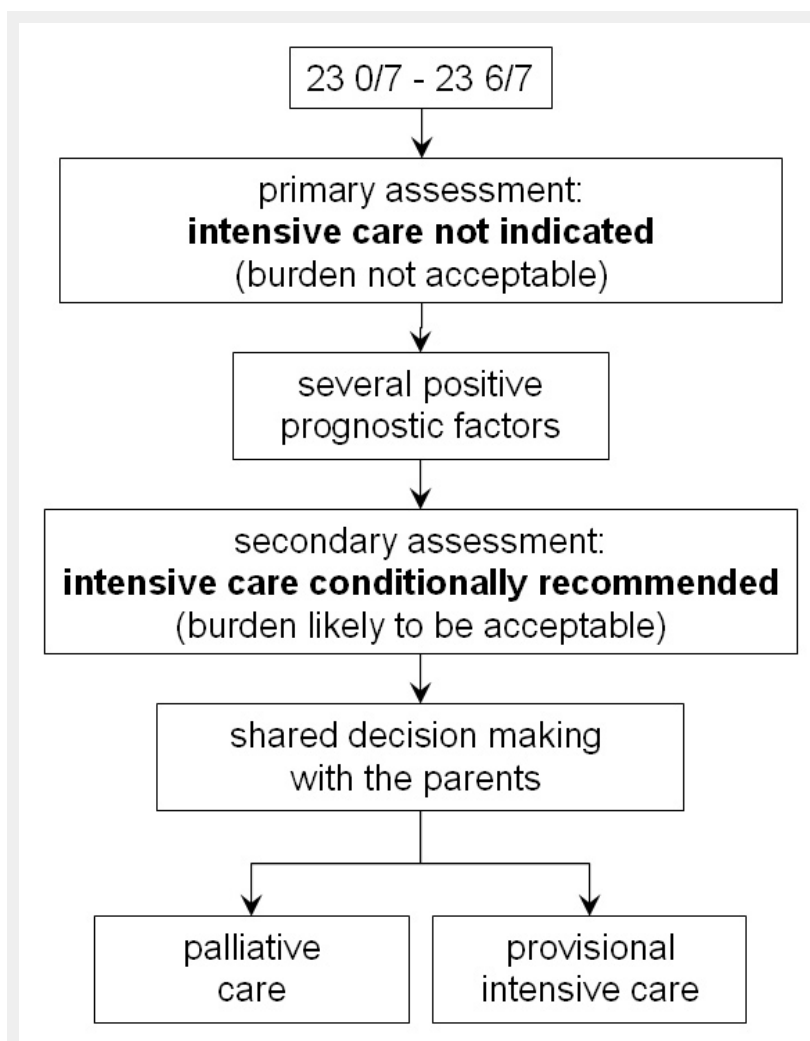
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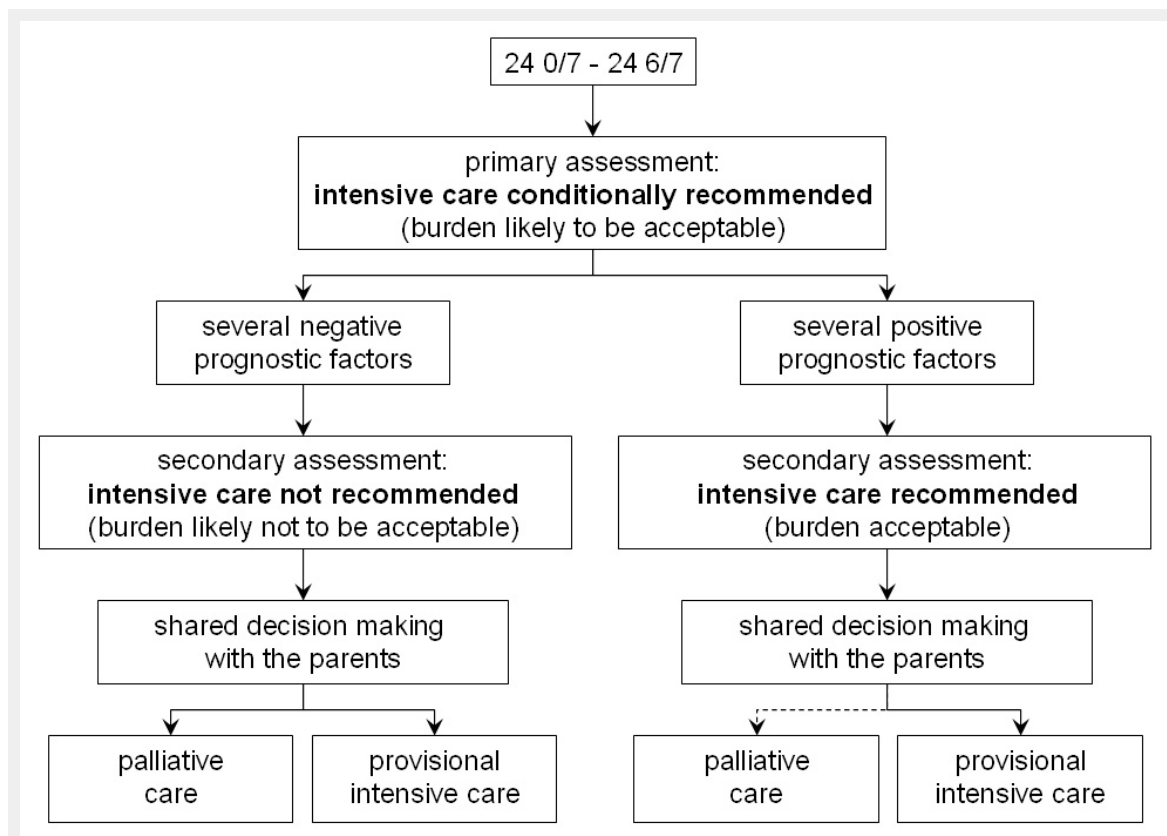
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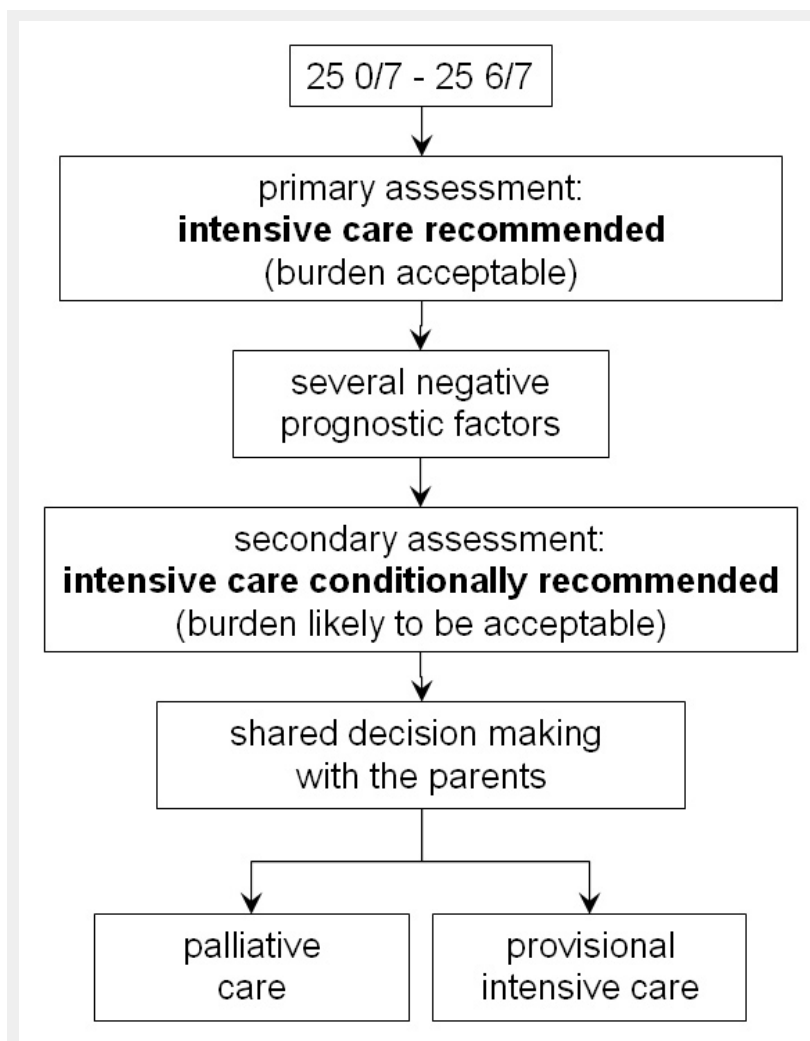
Figures (large format)

**Figure 1**

Impact of positive risk factors on shared decision making with the parents in preterm infants with a gestational age between 23 0/7 and 23 6/7 weeks.

**Figure 2**

Impact of positive or negative risk factors on shared decision making with the parents in preterm infants with a gestational age between 24 0/7 and 24 6/7 SSW.

**Figure 3**

Impact of negative risk factors on shared decision making with the parents in preterm infants with a gestational age between 25 0/7 and 25 6/7 SSW.